CRITERION 406

CROSS-CONNECTION CONTROL

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RECORD OF REVISIONS

Revision No.	Date	Description
0	08/27/98	Initial Issue.
1	09/06/01	Includes the addition of a Table of Contents, the use of Basis Statements in Section 6 and 7; further clarification based on the new criterion 101 Writer's Guide as well as the incorporation of ORPS & NRC lessons learned from 1/1/95 to 2/1/2000. This revision reflects the conversion from a WordPerfect document into a Microsoft Word document.
2	10/28/03	Qualification of certification and qualification of personnel performing backflow prevention device testing and repair. Additional definitions. Additions to Sections 1.0, 5.0, 7.0 and 8.0.

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CRITERION 406

CROSS-CONNECTION CONTROL

1.0 PURPOSE

The purpose of this Criterion is to establish the minimum requirements and best practices for the operation and maintenance of backflow prevention assemblies and cross-connection control. This document addresses the requirements of LIR 230-05-01, (Ref. 10.1) "Operations and Maintenance Manual."

The implementation of these requirements and recommendations satisfies DOE Order 430.1A, "Life Cycle Asset Management;" Attachment 2, "Contractor Requirements Document" Paragraph 2, Sections A through C, which in part requires UC to "…maintain physical assets in a condition suitable for their intended purpose" and employ "preventive, predictive, and corrective maintenance to ensure physical asset availability for planned use and/or proper disposition." Compliance with DOE Order 430.1A is required by Appendix G of the UC Contract.

Cross-connection control and backflow prevention are mandatory requirements under the New Mexico Drinking Water Regulations – 20NMAC7.1, Section 208 (Ref. 10.7) and Section 602 of the Uniform Plumbing Code (Ref. 10.9).

These regulations are designed to:

- Protect the potable water supply of Los Alamos National Laboratory (LANL) from the possibility of contamination or pollution by isolating within LANL's internal distribution system(s) such contaminants or pollutants that could backflow, due to back pressure or back siphonage, into the potable water system.
- Promote the elimination or control of existing cross connections, actual or potential, between LANL's in-plant potable water system(s), non-potable water systems, and plumbing fixtures.

2.0 SCOPE

The scope of this Criterion shall apply to the erection, installation, alteration, repair, relocation, replacement, addition to, and use or maintenance of plumbing systems of LANL facilities where potable or non-potable water systems are involved and are subject to compromise through cross connection. This Criterion does not address corrective maintenance actions to repair or replace equipment.

The LANL complex has over 1200 buildings with connections to the water distribution system. This criterion applies to all building plumbing systems and modifications, repairs and alterations to building plumbing systems. Landscape watering systems and outside hose bibs are part of building plumbing systems.

3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AHJ	Authority Having Jurisdiction
AR	Administrative Requirements
AWWA	American Water Works Association
CFR	Code of Federal Regulations
DOE	Department of Energy
LIR	Laboratory Implementing Requirement
LIG	Laboratory Implementing Guidance
LPR	Laboratory Performance Requirement
MSE	Maintenance & System Engineering
O&M	Operations and Maintenance
PPE	Personal Protection Equipment
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
RPPBPD	Reduced Pressure Principle Backflow Preventer Device
SSC	Structures, Systems, and Components
SSS	Support Services Subcontractor for LANL
UC	University of California
UPC	Uniform Plumbing Code
USC/FCCC&HR	University of Southern California/Foundation for Cross-Connection Control and Hydraulic Research

3.2 Definitions

Air-Gap Separation. A physical separation between the free flowing discharge and of a potable water supply pipeline and an open or non pressure receiving vessel. The air-gap shall be at lease double the diameter of the supply pipe measured vertical above the top over flow rim of the vessel, in no case less that one inch.

Approved. The term "APPROVED" within these procedures refers to approval of a device by the authority having jurisdiction (AHJ) based on test data from the University of Southern California Research Foundation for cross-connection control.

Backflow Connection. Any arrangements whereby backflow can occur, including cross-connection, back siphons, pumping systems, etc.

Back Pressure. Backflow due to an elevation of pressure in the downstream piping system (by pump, elevation of piping, or steam and/or air pressure) above the supply pressure at the point of consideration which would cause, or tend to cause, a reversal of the normal direction of flow.

Back-Siphonage. A form of backflow due to a reduction in system pressure which causes a sub-atmospheric pressure to exist at a site in the water system.

Backflow Prevention Assembly. Any effective assembly used to prevent backflow into a potable water system.

Contaminant. Any substance that could, if introduced into the potable water supply, cause death, illness, spread disease, or has a high probability of causing such effects. Also defined as "high hazard."

Cross Connection. Any unprotected actual or potential connection between a potable water system used to supply water for drinking purposes and any source or system containing unapproved water or a substance that is not or cannot be approved as safe, wholesome and potable. Bypass arrangements, jumper connections, removable sections, swivel or changeover devices, or other devices through which backflow could occur, shall be considered to be cross connections.

Double Check Valve. An approved backflow device including at least two independently acting check valves, including shut off gate valves or ball valves at each side of the check valve assembly and suitable test cocks for testing.

Pollutant. Any substance that generally would not be a health hazard, but would constitute a nuisance, or be aesthetically objectionable, if introduced into the potable water supply. Also defined as "low hazard."

Potable Water. Water, which is satisfactory for drinking, culinary, and domestic purpose and meets the federal and state regulatory requirements.

Reduced Pressure Principle Backflow Preventer Device (RPPBPD).An approved device incorporating two or more check valves and an automatic deferential relief valve located between the two check valves including operating shut off gate valve or ball valves on each side of the assembly and suitable test cocks for testing.

Vacuum Breaker. An approved non-pressure anti-siphon device located on the discharge side of the last control shut off valve. To prevent back siphoning or an approved pressure anti-siphon device used in a supply line to prevent back siphoning.

4.0 RESPONSIBILITIES

4.1 FWO- Maintenance and System Engineering (MSE)

4.1.1 FWO-MSE is responsible for the technical content of this Criterion and monitoring the applicability and the implementation status of this Criteria and either assisting the organizations that are not applying or meeting the implementation expectations contained herein or elevating their concerns to the director(s).

Basis: LIR 301-00-01.11; Issuing and Managing Laboratory Operations Implementation Requirements and Guidance, Section 5.4, OIC Implementation Requirements.

4.1.2 FWO-MSE shall provide technical assistance to support implementation of this Criterion.

4.2 Facility Manager

4.2.1 Responsible for operations and maintenance of institutional, or Real Property and Installed Equipment (RP&IE) under their jurisdiction, in accordance with the requirements of this document.

4.2.2 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that may be assigned to the FM in accordance with the FMU-specific Facility/Tenant Agreement.

4.3 Group Leader

4.3.1 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that are under their jurisdiction

4.3.2 Responsible for system performance and subsequent replacement or refurbishment of assigned PP&PE.

4.4 Authority Having Jurisdiction (AHJ) – Mechanical POC for LANL Engineering Manual

4.4.1 The AHJ is responsible for providing a decision on a specific technical question regarding this criterion.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. A compilation of all applicable precautions shall be contained in the implementing procedure(s) or work control authorization documents. The following precautions are intended only to assist the author of a procedure or work control document in the identification of hazards/precautions that may not be immediately obvious.

5.1.1 Backflow devices which have been de-listed by USC/FCCC & HR can remain in service as long as the device satisfactorily passes the required annual testing and spare parts are available.

5.1.2 Do not shut water off to building without notification to occupants.

5.2 Limitations

The intent of this Criterion is to identify the minimum generic requirements and recommendations for SSC operation and maintenance across the Laboratory. Each user is responsible for the identification and implementation of additional facility specific requirements and recommendations based on their authorization basis and unique equipment and conditions, (e.g., equipment history, manufacturer warranties, operating environment, vendor O&M requirements and guidance, etc.). Nuclear facilities and moderate to high hazard non-nuclear facilities will typically have additional facility-specific requirements beyond those presented in this Criterion. Nuclear facilities shall implement the requirements of DOE Order 433.1 (Ref. 10.3) (or 10 CFR 830.340, Maintenance Management, when issued) as the minimum programmatic requirements for a maintenance program. Additional requirements and recommendations for SSC operation and maintenance may be necessary to fully comply with the current DOE Order or CFR identified above.

6.0 REQUIREMENTS

Minimum requirements that Criterion users shall follow are specified in this section. Requested variances to these requirements shall be prepared and submitted to FWO-MSE in accordance with LIR 301-00-02 (Ref. 10.4), “Variances and Exceptions to Laboratory Operations Requirements,” for review and approval. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on this analysis. Laws, codes, contractual requirements, engineering judgement, safety matters, and operations and maintenance experience drive the requirements contained in this section.

6.1 Operations Requirements

6.1.1 Ensure that there is no piping arrangement or connection by which an unsafe substance may enter the drinking water supply.

Basis: LIR 220-03-01, LANL Facility Engineering Manual, Chapter 6 – Mechanical, Section 201.3, which invokes the Uniform Plumbing Code (IAPMO). (Ref. 10.11) UPC required under Appendix G of the UC/DOE Contract.

6.2 Maintenance Requirements

6.2.1 The installation and replacement of the backflow prevention assembly shall comply with the requirements of the UPC.

A. The backflow prevention assembly shall be tested and/or repaired by a certified backflow assembly tester at the time of installation, repair or relocation and at least on an annual schedule thereafter or more frequently as defined in the facility authorization basis.

NOTE: Training and certification recognized by the LANL AHJ is University of Southern California Foundation for Cross-Connection Control and Hydraulic Research (USC) trained and certified by the American Water Works Association (AWWA) or by a person who has been trained and certified by an instructor authorized by LANL AHJ. The instructor shall be USC trained and certified by AWWA.

B. New or repaired backflow prevention assemblies on potable water systems shall be disinfected prior to use and shall comply with the requirements of the UPC.

Basis: LIR 220-03-01, LANL Facility Engineering Manual, Chapter 6 – Mechanical, Section 201.3, which invokes the Uniform Plumbing Code (IAPMO). (Ref. 10.11) UPC required under Appendix G of the UC/DOE Contract.

7.0 RECOMMENDATIONS AND GOOD PRACTICES

The information provided in this section is recommended based on acceptable industry practices and should be implemented by each user based on his/her unique application and operating history of the subject systems/equipment.

7.1 Operations Recommendations

7.1.1 Potable water systems should be surveyed for cross-connections. Frequencies of survey are generally based on risk to water supply from building operations.

For example:

Nuclear Chemistry Facilities - every two years

Waste Treatment Facilities - every two years

Transportable Office Buildings - every seven years

7.1.2 Connections or modifications to a building's potable water system should be reviewed, permitted, and approved by the facility manager. (FM)

7.2 Maintenance Recommendations

7.2.1 Provided it has been reviewed and approved by FWO-MSE, Support Services Subcontractor for LANL (SSS) craftsperson should comply with the "PMI 40-40-002, Backflow Preventer Maintenance Repair." procedure. (Ref. 10.8)

8.0 GUIDANCE

8.1 Operations Guidance

8.1.1 The AWWA Manual M14 "Recommended Practice for Backflow Prevention and Cross-Connection Control," (Ref. 10.6); the "Uniform Plumbing Code," and the USC "Manual of Cross-Connection Control" (USC/FCCC&HR) (Ref. 10.10) may be used as guides.

8.2 Maintenance Guidance

8.2.1 **Installation** -The installation of the backflow prevention assembly shall comply with the requirements of the Uniform Plumbing Code (UPC) and the Facilities Engineering Standards. The type of backflow prevention device used shall be determined by the degree of hazard. Generally, the following guidelines should apply.

8.2.2 **Air-Gaps** -Offer the greatest protection against backflow but entail added expense if downstream pressures are required. The installation of a faucet outlet above the rim of a lavatory is a typical air-gap example. Minimum air-gap shall be at least twice the effective opening of a potable water line, but not less than one inch in any case.

8.2.3 **Reduced Pressure** -RPPBP devices offer the next best prevention to backflow. Specific installations include:

A. Installed above ground in heated enclosure or have freeze protection, horizontally mounted devices shall be installed per the manufacturer's recommendation. The installation shall allow sufficient room above and below the device for removal and replacement of all internal components without removing the device from through line. Where an air-gap is not utilized, such as a cross-connection control filling station for water loading stations, an approved RPPBP shall be used after a fire hydrant.

B. Be readily available for inspection and equipped with test cocks for determining: supply pressure, relief zone pressure, and downstream pressure.

C. Have no bypass around the device. If water supply cannot be interrupted, a parallel RPPBP device shall be installed.

8.2.4 **Double Check Valves** -Provide an intermediate level of protection and may be installed where approved. Assemblies shall be complete with two shut off valves and test cocks.

8.2.5 **Pits** - where double check valves are installed for landscape irrigation, adequate drainage must be provided to prevent flooding of the pit and device.

8.2.6 **Atmospheric Vacuum Breakers** -Shall be installed on the atmospheric side of fixture flow control valves to prevent back siphoning. The device should be located as near the fixture as possible and sufficiently above the fixture flood level rim to prevent submergence of the vacuum breakers. (Caution) atmospheric vacuum breakers are designed to prevent back siphoning only and will not provide protection against backflow resulting from back pressure. Additionally, the relief disc will stick in the closed position if exposed to back-pressure and will not operate.

8.2.7 **Approved Pressure Vacuum Breakers** -Shall be installed where the system is not subject to any back-pressure and where the tank or system cannot under any circumstances exceed atmospheric pressure.

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained for the cross-connection program to include, as a minimum, the parameters listed in the Table 9-1 below:

Table 9-1 Documentation Parameters

MAINTENANCE HISTORY DOCUMENTATION PARAMETERS				
PARAMETER	**ML 1**	**ML 2**	**ML 3**	**ML 4**
Maintenance Activities				
Backflow Preventer Assembly Repair/Adjustments	**X**	**X**	**X**	**X**
PM: Backflow Preventer Assembly testing	**X**	**X**	**X**	**X**
Installation Assemblies	**X**	**X**	**X**	**X**
Inspection Results				
Survey/Inspection Date	**X**	**X**	**X**	**X**
Master Equipment List	**X**	**X**	**X**	**X**

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of LPR 230-07-00, Criteria 2, (Ref. 10.5) which states; "Maintenance activities, equipment problems, and inspection and test results are documented."

10.0 REFERENCES

The following references, and associated revisions, were used in the development of this document.

10.1 LIR 230-05-01.0, Operation and Maintenance Manual.

10.2 DOE O 430.1A, Attachment 2 "Contractor Requirements Document" (Paragraph 2, Sections A through C), a requirement of Appendix G of the UC Contract.

10.3 DOE Order 433.1, Maintenance Management Program for DOE Nuclear Facilities.

10.4 LIR 301-00-02.0, Variances and Exceptions to Laboratory Operation Requirements.

10.5 LPR 230-07-00, Maintenance History, Performance Criteria [2].

10.6 AWWA Manual M14, Recommended Practice for Backflow Prevention and Cross-Connection Control, 1990.

10.7 New Mexico Drinking Water Regulations– 20NMAC7.1, Title 20, Chapter 7, Part 1, Section 208, 1995.

10.8 SSS Procedure PMI 40-40-002, Backflow Preventer Maintenance and Repair.

10.9 Uniform Plumbing Code (UPC), 2000.

10.10 USC/FCCC & HR Manual of Cross-Connection Control, Ninth Edition.

10.11 LANL Facility Engineering Manual, Chapter 6, Section 200, 1999.

11.0 APPENDICES

None.